Proceedings, 10th World Congress of Genetics Applied to Livestock Production

# Genetic Analysis Of Hunting Traits In Norwegian Elkhounds

***M. Wetten***[*] **and T. Aasmundstad**[†]
[*]Geninova, Hamar, Norway, [†]Norsvin, Hamar, Norway

**ABSTRACT:** Genetic analyses of hunting traits in Norwegian Elkhounds reveal heritabilities of 3-12 %. These low heritabilities highlight the need of introducing breeding values in the selection for improved hunting skills in this breed. The effects of owner on the performance of the dogs are high. Analyses of the pedigree resulted in an average level of inbreeding of 3.7 % for dogs registered in 2012, indicating a healthy breed. These analyses are part of a larger project which aims at establishing a sustainable breeding program for the Norwegian Elkhound breed. This project will develop systems to estimate breeding values, tools for the control of inbreeding as well as systems for use and storage of biological materials. Methods and structure from Norwegian breeding programs for production animals will be adapted to dogs for establishment of permanent systems for sustainable dog breeding.

**Keywords:** Dog; Heritability; Hunting

## Introduction

Today, there is a great contrast between breeding of farm animals and breeding of dogs in Norway. While breeding of farm animals is built upon years of registrations of valuable traits, in later years also information about the genotype of the animals, estimated heritabilities and breeding values, this is missing in the breeding programs of most dog breeds. Breeders of farm animals have for decades seen the importance of controlling inbreeding in their populations. Furthermore, they have developed systems for the quantification of traits (i.e. conformation traits), which combined with statistical analyses allows them to make decisions for breeding based upon the~~n~~ genetic/breeding value of the animals instead of phenotype.

The Norwegian Elkhound Grey (NEG) is a popular breed for use in hunting of elk in Nordic countries. There are approximately 1000 pups registered each year in Norway. The breed's object in the hunt is to independently track down and hold the elk at bay, while signaling to the hunters by barking loudly. Breeding for these hunting traits is currently based on phenotypic selection, and phenotypes are registered based on the dogs own performance in one-day hunting trials. Trials are held outdoors under non-standardized conditions, and many environmental effects may therefore affect the trial results of each dog.

In this study we wanted to estimate the genetic effect on hunting trials of the breed Norwegian Elkhound Grey. Additionally, an overview of the level of inbreeding in the population is presented.

## Materials and Methods

**Data.** Phenotypes for the genetic analyses included registrations on 1857 dogs that had been tested in a one-day individual hunting field trial in the years 2005 to 2013. The data were kindly provided by the Norwegian Elkhound Association. Each individual dog and handler (owner) is tested and the trial is evaluated by a skilled judge. Only the first trial of each dog (some dogs are evaluated several times) are included in these analyses.

The hunting trial includes registration of 10 separate traits; 1) Quality of the search for the elk ('Search'), 2) Ability to find a elk ('Finding') which includes evaluation of the use of senses, tracking, utilization of the terrain, 3) Ability to keep the elk at bay ('Keep at bay'), 4) Quality of keeping the elk at bay ('Quality-bay'), 5) How the dog clings to the elk if the elk runs ('Clinging'), 6) How the dog conducts itself during baying ('Conducting'), 7) Loudness of the barking ('Loudness'), 8) Use of barking ('Barking'), a combination of rhythm, continuousness and number of barks per minute) 9) Willingness to keep contact with the leader ('Cooperation'), 10) How the dog follows commands from the leader ('Obedience').

Each registered trait is evaluated on a score from 1-10 where 1 is poor performance and 10 is excellent. Additionally, a weighted total score (Total) is estimated based on weights presented in Table 1. A pedigree that included only dogs with data and their relatives were used for the genetic analyses (5133 animals).

**Table 1. Traits registered in the hunting trial with numbers (N), means, standard deviation (St dev) and weight in the total score.**

| | N | Mean | St dev | Weight |
|---|---|---|---|---|
| Search | 1856 | 6.5 | 1.9 | 2 |
| Finding | 1591 | 7.1 | 2.1 | 1 |
| Keep at bay | 1545 | 6.9 | 3.2 | 1.5 |
| Quality bay | 1504 | 6.7 | 3.3 | 1 |
| Clinging | 1553 | 8.6 | 2.1 | 1.5 |
| Conducting | 1500 | 6.6 | 3.5 | 1 |
| Loudness | 1304 | 7.9 | 1.3 | 0.5 |
| Barking | 1283 | 8.4 | 1.8 | 0.5 |
| Cooperation | 1749 | 6.6 | 2.4 | 0.5 |
| Obedience | 1748 | 5.0 | 2.5 | 0.5 |
| Total | 1857 | 60.1 | 26.4 | |

For the estimation of inbreeding coefficients, the data included all animals in the available pedigree, in total 55 731 animals.

**Statistical analyses.** An animal model was used to estimate heritabilities. Included in the model were a fixed effect of season (within year), sex and a random effect of the owner. In total, season had 20 levels. Age of the animal was tested as a fixed regression, but was not found to be significant and therefore not included in the model. The DMU software package was used for the statistical analyses (Madsen and Jensen (2006)).

Inbreeding coefficients and Pedigree Completeness Index (PCI) were estimated in the EVA program (Berg et al. 2006). The complete pedigree was used for this analysis.

## Results and Discussion

Table 1 presents number of observations, means and standard deviations for each trait. Traits that could not be measured during a trial were set to missing. As the table indicates, the traits 'Search', 'Loudness' and 'Barking' are traits with the least variation. Additionally, the last column in Table 1 gives the weight each trait is given in the total score. As the weights indicate, the traits 'Search', 'Keep at bay' and 'Clinging' are important traits to the hunters.

Estimated heritabilities for the 11 traits in the analyses are presented in Table 2. The results show low heritabilities for all traits (0.03-0.12). The sizes of the standard errors are generally small. The most heritable traits are 'Use-barking' (0.12) and 'Loudness' (0.10). The three least heritable traits are 'Collaboration (0.03), 'Obedience' (0.04) and 'Clinging' (0.04). Due to the sizes of the standard errors these estimates are also not significantly different from zero.

**Table 2. Estimates of genetic parameters for traits registered on the hunting trial with standard error of the heritability (St. err).**

| Trait | Genetic | Owner | Residual | $h^2$ | St.err $h^2$ |
|---|---|---|---|---|---|
| Search | 0.19 | 0.30 | 3.00 | 0.05 | 0.03 |
| Finding | 0.22 | 0.46 | 3.63 | 0.05 | 0.03 |
| Keep at bay | 0.82 | 1.48 | 7.69 | 0.08 | 0.04 |
| Quality bay | 0.61 | 1.69 | 8.30 | 0.06 | 0.03 |
| Clinging | 0.17 | 0.21 | 3.99 | 0.04 | 0.03 |
| Conducting | 0.92 | 1.43 | 9.25 | 0.08 | 0.04 |
| Loudness | 0.19 | 0.06 | 1.56 | 0.11 | 0.05 |
| Barking | 0.40 | 0.02 | 2.91 | 0.12 | 0.05 |
| Cooperation | 0.18 | 0.00 | 5.40 | 0.03 | 0.03 |
| Obedience | 0.25 | 0.49 | 5.51 | 0.04 | 0.03 |
| Total | 45.25 | 55.45 | 574.11 | 0.07 | 0.03 |

Heritabilities reported in this study are lower than those reported by Schmutz and Schmutz (1998). They estimated heritabilities based on midparent-offspring regression in 5 different breeds evaluated on traits related to game-bird hunting. However, our results are in the same range as the results reported by Liinamo et al. (1997) who reported heritabilities of 0.01-0.15 for hunting performances in Finnish hounds estimated by an animal model. The most heritable trait reported by Liinamo et al. (1997) was 'Tounge frequency' (0.15). The report supports our estimate of the trait 'Barking' as the most heritable trait (0.12, Table 2). Liinamo et al. (1997) further reports heritabilities for 'Search score' of 0.05, and 'Obedience' of 0.02, which are very close to the result found in our study.

Heritabilities in populations of Norwegian Elkhounds in Finland have been reported by Liinamo (2009). They reported generally low heritabilities for hunting traits (<0.05), although heritabilities of 'Search spread' of 0.06 and bark density of 0.22 was presented.

The low heritabilities for hunting skills highlight the need of introducing breeding values in the selection for improved hunting skills also in the Norwegian population of Norwegian Elkhounds. However, these preliminary analyses do not answer the question whether low heritabilities are due to small genetic variance OR a large residual variance caused by limited control of the environmental factors affecting the phenotypes. As the trials are run under non-standardized conditions outside, it is expected a large environmental impact on the measured traits. Possibly, heritabilities could be improved if some of these environmental factors were recorded, so that they could be corrected for in the genetic analyses. Further, as the judges to some degree always will be subjective, improved protocols for evaluation of the traits, as well as frequent 'calibration 'of the judges to a given standard should be aimed at. Possibly, a judging team could also help.

Table 2 also presents estimates of the variance component associated to the owner of the dog. These estimates reflect a big impact of the owner on the registered phenotype, for several traits twice as large as the genetic effect. These effect are expected to be high on hunting traits, but would in general also be expected to affect any trait. Removing the effect of the owner in the model increased the genetic component in most traits, but also the residual variances (results not shown). Heritabilities increased by 0.0-1.5 percent when the random effect owner was removed from the model (Results not shown). The three traits 'Loudness', 'Barking' and 'Collaboration' had no changes in either genetic variance or residual variance, as these traits had very small variance components for the effect of owner initially (Table 2). The results indicate the importance of including 'handler' as an effect in the genetic analyses.

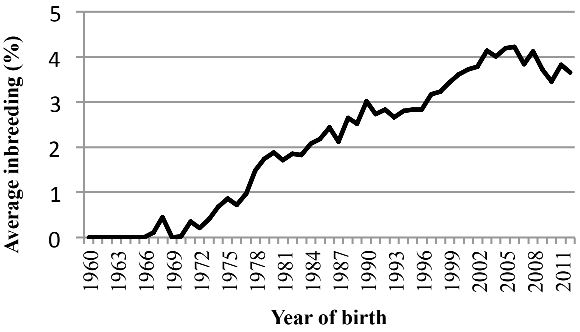

**Figure 1. Average inbreeding coefficients of registered dogs by birth year.**

Figure 1 gives average inbreeding of dogs registered by year of birth. As the figure shows, average inbreeding coefficients for dogs born in 2012 is 3.7 percent. With a generation interval of five years, the average increase in inbreeding per year is 0.4 percent over the period of the last 30 years on the population level, which is a sustainable increase. The average PCI six generations back was 95% for animals born in 2012.

## Conclusion

Hunting traits reveal in general low heritabilities. The results in this study indicate that a large proportion of the variance in hunting traits in Norwegian Elkhounds can also be descried as an effect of the owner/handler. The low heritabilities for hunting skills highlight the need of introducing breeding values in the selection for improved hunting skills in the Norwegian Elkhounds. For the future, hunters should aim at standardizing the hunting trials as much as possible.

## Literature Cited

Berg P., Nielsen J. and Sørensen M.K. 2006. *proc. WCGALP*, 2006, s.246.

Liinamo, A. –E. (2009). http://www.eaap.org/Previous_Annual_Meetings/2009Barcelona/Papers/07_Liinamo.pdf/ Accessed on Feb 2014.

Liinamo, A.-E., Karjalainen,L., Ojala, M et al. 1997. *Journal of Animal Science* 75 622-629.

Madsen, P., and Jensen, J.A. (2006). DMU. Version 6, release 4.6

Ruefenacht, S., Gebhart-Henrich, S., Miyake, T., et al. (2002) *Applied Animal Behaviour Science* 79.2 113-132.

Schmutz, S.M. and Schmutz, J.K. (1998). *Journal of Heredity* 89.3 233-237.